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09/694,090	10/19/2000	Philippe Guyot-Sionnest	7814/43	7386

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EXAMINER	
UHLIR, NIKOLAS J	
ART UNIT	PAPER NUMBER
1773	7

DATE MAILED: 06/13/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary	Application No. 09/694,090	Applicant(s) GUYOT-SIONNEST ET AL.
	Examiner Nikolas J. Uhlir	Art Unit 1773

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on ______ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-33 is/are pending in the application.

4a) Of the above claim(s) ______ is/are withdrawn from consideration.

5)☐ Claim(s) ______ is/are allowed.

6)☒ Claim(s) 1-33 is/are rejected.

7)☐ Claim(s) ______ is/are objected to.

8)☐ Claim(s) ______ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on ______ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on ______ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ______ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 6 .
4) ☐ Interview Summary (PTO-413) Paper No(s). ______ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

1. Claims 10-20 and 31 are noted to contain nominal method steps. At this time restriction has not been required between the product claims 1-9 and the method claims 21-30 and 32-33 because the method claims do not recite any significant manipulative steps and therefore considered as part of the product claims. If the method claims are amended to contain significant method steps they will be subject to restriction based on original presentation.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in-
> (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
> (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

3. Claims 1, 2, 4-13, 15-27, and 29-31 are rejected under 35 U.S.C. 102(b) as being anticipated by Bhargava (US5446286) as evidenced by Sher et al. (US4529832).

4. The limitation "prepared by the method of" present in claims 21-27 is product by process limitation and does not appear to be further limiting in so far as the structure of the product is concerned. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The

patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). See MPEP § 2113. In the instant case the examiner takes the position that the material taught by Bhargava meets all of the structural limitations of claims 10-13 and 17-18 and 20 (upon which claims 21-27 are dependent) although it may be made from a different process.

5. Bhargava teaches a solid-state sensor or detector for radiation comprising an active layer made from doped nano-crystals (DNC). These DNC compounds are quantum-confined, separated, tiny insulating particles with dimensions of 100 angstroms or less (column 3, lines 59-65). These DNC compounds are typically II-VI semiconductor compounds having a band-gap in excess of 2 electron volts. These compounds include base materials such as Zinc Oxide (ZnO), Cadmium Sulfide (CdS), and Cadmium Selenide (CdSe) (column 4, lines 3-12) doped with rare earth and transition metal elements, such as Manganese (Mn) (column 4, lines 21-24). Bhargava teaches that very thin layers (<1000 angstroms thick) can be made by applying several layers of these doped nano-crystal particles to a substrate (column 3, lines 59-column 4, line 2). Bhargava teaches a method for manufacturing these particles that ensures that undoped particles are doped with the desired activator, and that the particles are kept separate. The particles must be kept separate in order to exhibit quantum confined effects (column 6, lines 19-28). Bhargava specifically teaches doping semiconductor

nanocrystals by first forming a solution containing diethylmanganese and diethylzinc in toluene, and then adding hydrogen sulfide to the solution, whereafter a precipitation reaction ensues resulting in manganese (Mn^{2+}) doped zinc sulfide particles (column 7, lines 2-23). Further, Bhargava teaches a layer of doped nano-crystals can be coupled with a ferro electric material to form an opto-electronic memory device (column 4, lines 62-68). Regarding claims 2, 11, 12 and 13 wherein the applicant requires the addition of a carrier such as an electron either through contacting a semiconductor nano-crystal with a oxidizing or reducing agent, or electrochemically. The examiner takes the position that when Manganese (Mn) is added to a semi-conductor such as CdS as a dopant as taught by Bhargava et al., the result will be the formation of n-doped semiconductor nano-crystals. It is well known in the art that CdS can be doped n-type, but cannot be doped p-type, as evidenced by Sher et al. (Sher et al. column 4, lines 19-20). Bhargava et al. teaches that Mn^{2+} is doped into the semiconductor host material (column 3, line 53 and column 7, lines 2-23). Thus, the examiner takes the position that Mn is a reducing element that will donate electrons to a semiconductor host material such as Cadmium Sulfide through an oxidation-reduction reaction, wherein Mn is oxidized to Mn^{2+} and the semiconductor host material is reduced. Thus, the semiconductor possesses one or more electrons as a carrier, and is therefore n-type. Therefore, the limitations of claims 2, 11, and 13 are met. The examiner takes the position that doping a semiconductor with an element that either donates or accepts electrons constitutes an oxidation-reduction reaction and is therefore an electrochemical process. Thus the limitation of claim 12 is met. Regarding claim 31, wherein the applicant claims a method for making

a substrate appear cooler or warmer to an IR detector, comprising coating said object with a plurality of the particles of claim 1, the examiner takes the position that this limitation is necessarily met. The applicant has not required any significant method step in claim 31 other than applying a plurality of doped semiconductor nanocrystals to a substrate. Bhargava clearly teaches applying several layers of doped semiconductor nanoparticles to a substrate to form a layer (column 3, line 68-column 4 line 2). The examiner takes the position that the infrared properties of doped semi-conductor nanocrystals are material properties. Thus, because the material taught by Bhargava meets all of the material limitations of claims 1, 2, 4-13, 15-27, and 29-31 and is applied to a substrate, this limitation is necessarily met.

6. Claims 1-5, 10-16, and 21-24 are rejected under 35 U.S.C. 102(a) as being anticipated by Gray et al. (US5985173) as evidenced by Sher et al. (US4529832).

7. The limitation "prepared by the method of" present in claims 21-24 are product by process limitations and do not appear to be further limiting in so far as the structure of the product is concerned. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). See MPEP § 2113. In the instant case the examiner takes the position that the material

taught Gray et al. meets all of the structural limitations of claim 10 (upon which claims 11, 12, and 21-24 are dependant) although it may be made from a different process.

8. Gray et al. teaches phosphors that are made from doped nano-crystalline semiconductor particles (column 1, lines 60-63). These phosphors comprise a large band-gap semiconductor core capped with a large band-gap shell surrounding the core (column 3, lines 13-15 and 20-25). Examples of semiconductors suitable for the core include Cadmium Sulfide (CdS), and Zinc Sulfide (ZnS), which are II-VI binary semiconductor compounds (column 4, lines 46-48 and 52-55). These semi-conductors are doped with a wide range of dopants, such as Manganese (Mn), Silver (Ag), Copper (Cu), and Chlorine (Cl) (Column 6, lines 10-16). Suitable materials for the outer shell include wide band-gap inorganic passivating agents such as ZnO (column 5, lines 64-67). Regarding claims 2, 3, and 11: Although Gray et al. does not teach that the doped semi-conductor particles are "n-doped" or "p-doped," the examiner takes the position that these limitations are necessarily met. Gray et al. clearly teaches doping semiconductor host materials with manganese and chlorine. It is well known in the art that CdS can be doped n-type, but cannot be doped p-type, as evidenced by Sher et al. (Sher et al. column 4, lines 19-20). Thus, the examiner takes the position that Manganese is a reducing element that when doped into a semiconductor host such as Cadmium Sulfide will donate electrons to the semiconductor host through an oxidation-reduction reaction, resulting in the semiconductor possessing one or more electrons as carriers, thereby resulting in an n-type semiconductor. The examiner further takes the position that Chlorine is an oxidizing element that when doped into a semiconductor

host material such as Cadmium Selenide will accept electrons from the semiconductor host through an oxidation reduction reaction, wherein chlorine is reduce to Cl^- and the semiconductor is oxidized, resulting in the formation of a hole carrier, and therefore a p-doped semiconductor. Thus, because Gray et al. teaches doping CdS and CdSe respectively with these elements, the limitations of claims 2, 3 and 11 are met. Regarding claims 13 and 14: Although Gray et al. does not specifically teach semiconductor nano-crystals that are doped with either an electron or a hole, the examiner takes the position that these limitations are necessarily met as stated above, as it is well known that n-type semiconductors possess on or more electrons as carriers and p-type semiconductors possess on or more holes as carriers. Regarding claim 12, wherein the applicant requires "wherein said adding comprises oxidizing or reducing electrochemically." The examiner takes the position that doping a semiconductor with an element that either donates or accepts electrons constitutes an oxidation-reduction reaction and is therefore an electrochemical process. Thus the limitation of claim 12 is met.

9. Claims 1-2. 4-6, 8, 10-13, 15-17, 19, and 21-25 are rejected under 35 U.S.C. 102(a) as being anticipated by Gallagher et al. (US6048616) as evidenced by Sher et al. (US4529832).

10. The limitation "prepared by the method of" present in claims 21-25 are product by process limitations and do not appear to be further limiting in so far as the structure of the product is concerned. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The

patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). See MPEP § 2113. In the instant case the examiner takes the position that the material taught by Gallagher et al. meets all of the structural limitations of claim 10-13 and 17 (upon which claims 21-25 are dependant) although it may be made from a different process.

11. Gallagher et al. teaches encapsulated quantum sized doped semiconductor nanocrystals that exhibit quantum effects (column 1, lines 10-16). Gallagher et al. teaches that the semiconductor host material can be Zinc Selenide, Zinc Telluride, Cadmium Sulfide (CdS), and Cadmium Selenide (CdSe), and may be doped with elements such as Manganese and Cerium (column 5, line 66-column 6, line 12). Gallagher et al. specifically teaches a process for doping semi-conductor nanoparticles with manganese, wherein the semiconductor nanocrystals are doped with manganese during particle formation in solution (column 2, lines 30-63). Further, Gallagher et al. teaches coating the surface of the particles with a surfactant such as poly(methyl)methacrylate in order to keep the particles separate, thereby maintaining their quantum confinement effects (column 2, line 64-column 3, line 20). This coating meets the definition of a capping group provided by the applicant on page 4 line 30-page 5, line 1 of the specification. Regarding claims 2, and 10-13 wherein the applicant requires the particles to be "n-doped" via an oxidizing/reducing agent or electrochemical

process. Although Gallagher et al. does not specifically teach that the doped semi-conductor particles are "n-doped," via these methods, the examiner takes the position that these limitations are necessarily met. As stated above for the Bhargava and Gray et al. references, the examiner takes the position that Mn is a reducing element that when doped into a Semiconductor nanocrystal such as CdS results in the formation of an n-type semiconductor through an oxidation-reduction reaction. This is particularly true for CdS, which is known to be able to be able to be n-doped, but not p-doped, as evidenced by Sher et al. (Sher et al. Column 4, lines 19-20). Thus, because Gallagher et al. also teaches doping a CdS with Mn, the limitations of claims 2, 3, 11, and 13 are necessarily met. The examiner takes the position that doping of a semiconductor with an element that donates or accepts electrons constitutes an oxidation-reduction reaction, and is therefore an electrochemical process. Thus, the limitation of claim 12 is met.

12. Claims 1, 2, 4-13, 15-27, and 31 rejected under 35 U.S.C. 102(e) as being anticipated by Bhargava et al. (US6241819) as evidenced by Sher et al. (US4529832).

13. For the purpose of avoiding confusion with the first Bhargava reference, the examiner refers to this reference (Bhargava et al.) reference as "Bhargava 819."

14. The limitation "prepared by the method of" present in claims 21-27 are product by process limitations and do not appear to be further limiting in so far as the structure of the product is concerned. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in

the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). See MPEP § 2113. In the instant case the examiner takes the position that the material taught Bhargava 819 meets all of the structural limitations of claims 10-13, 17-18, and 20 (upon which claims 21-27 are dependant) although it may be made from a different process.

15. Bhargava 819 teaches a method for manufacturing doped semiconductor nanocrystals. In particular, Bhargava 819 teaches an activator doped quantum confined host material comprising ZnS doped with Manganese (column 1, lines 15-17). The method for manufacturing these materials comprises the following steps: 1. Forming a solution of polyethylene oxide (PEO) (a known polymer electrolyte), a metal halide compound containing the metal ion of the semiconductor host particle, and a metal halide of the dopant into a suitable solvent. 2. Casting the solution onto a substrate to form a film. 3. Dipping the film into a hydrocarbon solvent containing the other chemical component needed to form the host semiconductor material, during which the doped nanocrystals are slowly formed within the PEO matrix over a period of weeks (column 2, lines 17-33). In addition to ZnS, other semiconductor host materials may be used, such as CdSe and CdS, along with other dopants, such as copper, silver, thallium, cerium, titanium, etc... (Column 4, lines 35-44). The PEO is present to prevent the particles from clumping together, which ruins their quantum effects (column 3, lines 42-45). This coating of PEO meets the definition of a capping group provided by the applicant on

page 4 line 29-page 5 line 1 of the specification. These doped nanocrystals emit light significantly faster than those of the corresponding bulk material, and have applications in the development of next generation televisions and displays, where speed is important (column 2, lines 34-50). Regarding claims 2, and 10-13 wherein the applicant requires the particles to be "n-doped" via an oxidizing or reducing agent or electrochemical process. Although Bhargava 819 does not specifically teach that the doped semi-conductor particles are "n-doped," the examiner takes the position that these limitations are necessarily met. As stated above for the Bhargava and Gray et al. references, the examiner takes the position that Mn is a reducing element that when doped into a Semiconductor nanocrystal such as CdS results in the formation of an n-type semiconductor. This is due to the fact that it is well known in the art that CdS can be doped n-type, but not p-type, as evidenced by Sher et al. (Sher et al. Column 4, lines 19-20). Thus, because Bhargava 819 also teaches doping CdS with Mn, the limitations of claims 2, 3, 11, and 13 are necessarily met. The examiner further takes the doping of a semiconductor compound with an element that donates or accepts electrons constitutes an oxidation-reduction reaction, and is therefore an electrochemical process. Thus, the limitation of claim 12 is met.

Claim Rejections - 35 USC § 103

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. Claims 1, 28-29, and 32-33 rejected under 35 U.S.C. 103(a) as being unpatentable over Alivasitos et al. (US5537000) in view of Bhargava et al. (US6241819).

18. For the purpose of avoiding confusion, Bhargava et al. is referred to as Bhargava 819.

19. Alivasitos et al. teaches an electro luminescent device that is characterized by the ability to emit visible light in response to excitation of semiconductor nano-crystals (column 2, lines 14-18). Referring to figure 5, this electro luminescent device comprises a transparent glass support (2), a hole injection layer (10), a hole transport layer (20), an electron transport layer (30), and an electron injection layer (40). The hole injection layer (2) is a layer of indium tin oxide or other p-type semiconductor having a band gap greater than 3 eV (column 4, lines 45-65). The hole transport layer is a conductive polymer such as poly p-paraphenylene (column 5, lines 14-17). The electron transport layer is comprised of one or more monolayers of semiconductor nano-crystals, such CdS, CdSe, and ZnSe (column 5, line 60-column 6, line 7). When a potentiometer is adjusted to provide a voltage of about 2 volts, the zone where a hole recombines with an electron (recombination zone) falls within the electron transport layer, and gradually moves towards the hole transport layer as voltage is increased. The examiner takes the position that position of this recombination zone defines the border of an n-p junction.

20. Alivasitos et al. does not teach using doped semiconductor nano-crystals to manufacture an electro luminescent display. Alivasitos et al. also does not teach a display comprising doped semiconductor nanocrystals and a polymer electrolyte.

21. Bhargava 819 teaches a method for manufacturing doped semiconductor nanocrystals. In particular, Bhargava 819 teaches an activator doped quantum confined host material comprising ZnS doped with Manganese (column 1, lines 15-17). The method for manufacturing these materials comprises the following steps: 1. Forming a solution of polyethylene oxide (PEO) (a known polymer electrolyte), a metal halide compound containing the metal ion of the semiconductor host particle, and a metal halide of the dopant into a suitable solvent. This is followed by casting the solution onto a substrate to form a film, after which the film is dipped in a hydrocarbon solvent containing the other chemical component needed to form the host semiconductor material, during which the doped nanocrystals are slowly formed within the PEO matrix over a period of weeks (column 2, lines 17-33). In addition to ZnS, other semiconductor host materials may be used, such as CdSe and CdS, along with other dopants, such as copper, silver, thallium, cerium, titanium, etc… (column 4, lines 35-44). The PEO is present to prevent the particles from clumping together, which ruins their quantum effects (column 3, lines 42-45). These doped nanocrystals emit light significantly faster than those of the corresponding bulk material, and have applications in the development of next generation televisions and display, where speed is important (column 2, lines 34-50).

22. Therefore it would have been obvious to one with ordinary skill in the art at the time the invention was made to substitute the PEO coated doped semiconductor nanocrystals taught by Bhargava 819 for the un-doped semiconductor nanocrystals taught by Alivasatos et al.

23. One would have been motivated to make this modification due to the teaching in Bhargava 819 that doped semiconductor nano-crystals that have been coated with PEO exhibit extremely fast emission of light, which is particularly useful for the development of next generation TV's and displays.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nikolas J. Uhlir whose telephone number is 703-305-0179. The examiner can normally be reached on Mon-Fri 7:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Thibodeau can be reached on 703-308-2367. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-0389.

NJU
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June 10, 2002

Paul Thibodeau
Paul Thibodeau
Supervisory Patent Examiner
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